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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	**Application No.** 10/792,322	**Applicant(s)** LEE ET AL.
	Examiner Li Liu	**Art Unit** 2613

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 August 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 August 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1-20 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 1 recites the limitation "a semiconductor optical amplifier (SOA) configured to amplify the optical signal in a gain saturation state and the mode partition noise of the optical signal, wherein said noise intensity is **increased** and rendered substantially constant". Claim 6 recites the limitation "a semiconductor optical amplifier configured to amplify the upstream optical signal to be demultiplexed in a gain saturation state, ..., wherein a noise intensity in each of said upstream and downstream optical signals is **increased**. Claim 16 recites the limitation "amplifying, in a gain saturation state, the optical signal, wherein said intensity of the mode-partition noise is **increased** and rendered substantially constant."

However, in the original disclosure, nowhere does the applicant define or disclose that after the SOA, "the noise intensity is **increased** and rendered substantially constant".

Contrarily, the original disclosure states "[t]he spectrum-sliced light source is ***limited in transmission distance and speed***, due to **mode partition noise** generated between channels when light having a wide wavelength band is divided into channels having different wavelengths, the divided channels are modulated at high speed, and the modulated channels are transmitted." And, "[t]he present invention has been made to **solve the above-mentioned problems** occurring in the prior art, and an object of the present invention is to provide a stable multi-wavelength optical transmitter which can be employed in a wavelength division multiplexing system having ***stable transmission distance and transmission speed***." (page 2, line 1 to page 3 line 9).

The applicant also discloses that "multiplexed optical signals are amplified by the SOA 150 in a gain saturation state, so that **relative intensity noise** due to intensity difference between each channel is also **reduced**." (page 6, line 20 to page 7 line 1). And "according to the present invention, the SOA 150 operates in the gain saturation region, so that the mode-locked channels received in amplifier 150 **minimize relative intensity noise** of the multiplexed optical signal" (page 8, line 9-11).

As is well known in the art, mode partition noise is inherent in any laser with more than one resonant mode, e.g., the typical F-P injection laser used in the application, and is an intrinsic property of the FP laser; the multiple longitudinal operation may also exhibit excess intensity noise owing to the mode partition noise as the various modes turn on and off. Mode partition noise can be observed even if the laser is mode locked, and it appears as an extreme increase in the relative intensity noise (RIN) spectrum at low frequencies. Mode partition noise limits the available signal-to-noise ratio (SNR),

therefore, limits the transmission distance and speed. The relative intensity noise and mode partition noise are mutually accountable.

The original specification discloses that the SOA is used to minimize the relative intensity noise, so to also reduce the mode partition noise (Figures 7 and 8). And, "an optical signal, into which a plurality of mode-locked channels are multiplexed, is amplified by an SOA in a gain saturation state, so that mode partition noise due to a partition of each channel is compensated. As a result, loss of each channel due to the mode partition noise is compensated, yielding an improvement in transmission speed and transmission distance" (page 12, line 21 to page 13 line 3). Therefore, the mode partition noise after the SOA operated in gain saturation state is reduced, not increased.

3. Claims 1-20 rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 1, 6 and 16 recite the "the noise intensity is increased" after the SOA amplification. The original disclosure does not describe how the SOA operated at gain saturation state can increase the partition noise, and how the system distance and speed can be improved while the mode partition noise is increased.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1, 2, 4, 5, 16, 17, 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al (US 2003/0142978) in view of Lee et al (US 2001/0004290) and Watanabe (US 6,847,758).

1). With regard to claim 1, Lee et al (Lee '978) discloses a multi-wavelength optical transmitter (Figures 1 and 6) for multiplexing a plurality of channels having different wavelengths into an optical signal so as to output the signal, the multi-wavelength optical transmitter comprising:

a plurality of lasers (Tx{B} 101-103 in Figure 1, or Tx{B} in Figure 6) configured to generate, by corresponding incoherent light (e.g., broadband light source 112 in Figure 1) received in the lasers, a plurality of mode-locked channels having different wavelengths ([0004], [0008] and [0014]), and a mode partition noise between said mode-locked channels (the mode partition noise is inherent in any laser with more than one resonant mode, e.g., the typical F-P injection laser as used in Lee's system, and is an intrinsic property of the FP laser, therefore, the mode partition noise is inherently generated in Lee's system), each of said mode partition noise having different wavelengths (as is well known in the art, the mode partition noise is generated between the optical signals since the F-P laser modulates spectrum-sliced optical signals at a high speed and outputs the modulated signals, it is inherent that the mode partition noise having different wavelengths).

a multiplexer/demultiplexer (110 or 115 in Figure 1, or 610 or 618 in Figure 6) configured to multiplexing the plurality of mode-locked channels and the mode partition noise into an optical signal;

Lee et al (Lee '978) discloses an optical amplifier for amplifying the outputted optical signal (508 in Figure 5) and output the optical signal having the plurality of mode-locked channels (Figure 5) and the mode partition noise (the mode partition noise is intrinsically with the mode-locked channels).

But, Lee et al does not expressly disclose (A) each of the mode partition noise having different intensities; and (B) a semiconductor optical amplifier (SOA) configured to amplify the optical signal in a gain saturation state and the mode partition noise of the optical signal, and said noise intensity is rendered substantially constant, said SOA being configured to output the optical signal having the plurality of mode-locked channels, and the relatively constant intensity mode partition noise.

With regard to item (A), Lee et al (Lee '978) teaches the compensation of the transmission loss and does not expressly address the noise in company with the mode-locked channels. However, in another patent application (Lee '290), Lee et al discloses a plurality of mode-locked channels having different wavelengths and a mode partition noise between said mode-locked channels (Figures 6-11), each of said mode partition noise having different wavelengths and different intensities (Figures 6-11); and the multiplexer/demultiplexer (the (D)MUX in Figures 3 and 4) multiplex the mode-locked channels and the mode partition noise into the optical signal.

As disclosed by Lee et al (Lee '290) and also well known in the art, the mode partition noise are always in company with the mode-locked channels for the incoherent light injected F-P laser. Therefore, it is obvious that the mode partition noise having different wavelengths and different intensities are generated in the system of Lee '978 and the multiplexer/demultiplexer multiplexes the noise components into the optical signal.

With regard to item (B), Watanabe, in the same field of endeavor, discloses a semiconductor optical amplifier (SOA) for amplifying an outputted optical signal in a gain saturation state (gain-saturated optical amplifier 6 in Figure 1, and Figure 6, column 9 line 23-30). By amplifying the optical signal in the gain-saturated region, the waveform distortion and the amplitude fluctuations near the peak of each pulse can be suppressed, and the transmission distance can be increased (column 8, line 23-67).

It is a well-known fact that when a amplifier is gain saturated, the signal output level change is small compared with the input level change; due to this characteristic, signal variation in input signal can be reduced (also refer to the prior art cited in the conclusion, Inoue: "Suppression of Signal Fluctuation Induced by Crosstalk Light in a Gain Saturated Laser Diode Amplifier"). Refer to Figures 5 and 12 of Watanabe, which show the gain curves; as the input light intensity exceeds a predetermined value (e.g., P_{so} in Figure 5 or ~20 mW in Figure 12), the gain value gradually flattens. Using this property, if the average intensity (or power) of a light source having intensity noise is located in a gain saturation region, the amplitude variation of the light according to time is reduced due to the gain saturation property. As shown in Figures 5 -12 of Watanabe,

reduction of the amplitude variation of the light source due to the SOA under a gain saturation driving condition means that the relative intensity noise of a signal channel is suppressed. That is, the gain-saturated semiconductor optical amplifier has a property that, if the gain saturation occurs, the intensity of amplified output light varies little and is constantly outputted even though the intensity of input light varies, and the reduction of the power fluctuation decreases relative intensity noise; therefore, the noise intensity is rendered substantially constant.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the gain-saturated SOA as taught by Watanabe in the system of Lee et al so that the fluctuation of the pulse intensity or the waveform can be suppressed and the intensity noise of the incoherent light source can be effectively reduced or the SOA outputs the reduced relatively constant intensity mode partition noise, and transmission distance can be increased.

2). With regard to claim 2, Lee et al and Watanabe discloses all of the subject matter as applied to claim 1 above. And Lee et al in view of Watanabe further discloses the multi-wavelength optical transmitter, further comprising:

a broadband light source (112 or 111 broadband light sources in Figure 1, [0008]) configured to generating light having a wide wavelength band including a plurality of incoherent lights having different wavelengths; and

a circulator (504 in Figure 5, 613 in Figure 6) configured to output the multiplexed optical signal to the SOA, and sending light that is outputted from the broadband light

source to the multiplexer/demultiplexer (B-band light is send to multiplexer/demultiplexer 110 through 504 in Figure 5),

wherein the multiplexer/demultiplexer (110 in Figure 1) demultiplexes said light that is outputted from the broadband light source into a plurality of incoherent lights having different wavelengths so as to output the demultiplexed incoherent light among the lasers ([0012]).

3). With regard to claim 4, Lee et al and Watanabe discloses all of the subject matter as applied to claim 1 above. And Lee et al in view of Watanabe further discloses wherein the multiplexer/demultiplexer includes an arrayed waveguide grating ([0061], and claim 9).

4). With regard to claim 5, Lee et al and Watanabe discloses all of the subject matter as applied to claim 1 above. And Lee et al in view of Watanabe further discloses wherein the lasers include a Fabry-Perot laser configured to generate a respective mode-locked channel by incoherent light ([0014]).

5). With regard to claim 16, Lee et al discloses a method for multiplexing comprising:

generating (Tx{B} and Tx{A} in Figures 1 and 6), by corresponding incoherent light received (broadband light sources 111 and 112 in Figure 1 and 611, and 612 in Figure 6), a plurality of mode-locked channels having different wavelengths ([0004], [0012]-[0015]) and a mode partition noise between said mode-locked channels (the mode partition noise is inherent in any laser with more than one resonant mode, e.g., the typical F-P injection laser as used in Lee's system, and is an intrinsic property of the

FP laser, therefore, the mode partition noise is inherently generated in Lee's system), each of said mode partition noise having different wavelengths (as is well known in the art, the mode partition noise is generated between the optical signals since the F-P laser modulates spectrum-sliced optical signals at a high speed and outputs the modulated signals, it is inherent that the mode partition noise having different wavelengths).

multiplexing (110 and 115 in Figure 1, or 610 and 618 in Figure 6) the plurality of mode-locked channels and the mode partition noise into an optical signal;

amplifying (507 and 508 in Figure 5) the received optical signal.

Lee et al (Lee '978) discloses an optical amplifier for amplifying the outputted optical signal (508 in Figure 5) and outputting the optical signal having the plurality of mode-locked channels (Figure 5) and the mode partition noise (the mode partition noise is intrinsically with the mode-locked channels).

But, Lee et al does not expressly disclose (A) each of the mode partition noise having different intensities; and (B) amplifying the optical signal in a gain saturation state, wherein said noise intensity is rendered substantially constant, and outputting the optical signal having the plurality of mode-locked channels, and the mode-partition noise.

With regard to item (A), Lee et al (Lee '978) teaches the compensation of the transmission loss and does not expressly address the noise in company with the mode-locked channels. However, in another patent application (Lee '290), Lee et al discloses a plurality of mode-locked channels having different wavelengths and a mode partition

noise between said mode-locked channels (Figures 6-11), each of said mode partition noise having different wavelengths and different intensities (Figures 6-11); and the multiplexer/demultiplexer (the (D)MUX in Figures 3 and 4) multiplex the mode-locked channels and the mode partition noise into the optical signal.

As disclosed by Lee et al (Lee '290) and also well known in the art, the mode partition noise are always in company with the mode-locked channels for the incoherent light injected F-P laser. Therefore, it is obvious that the mode partition noise having different wavelengths and different intensities are generated in the system of Lee '978 and the multiplexer/demultiplexer multiplexes the noise components into the optical signal.

With regard to item (B), Watanabe, in the same field of endeavor, discloses a semiconductor optical amplifier (SOA) for amplifying an outputted optical signal in a gain saturation state (gain-saturated optical amplifier 6 in Figure 1, and Figure 6, column 9 line 23-30). By amplifying the optical signal in the gain-saturated region, the waveform distortion and the amplitude fluctuations near the peak of each pulse can be suppressed, and the transmission distance can be increased (column 8, line 23-67).

It is a well-known fact that when a amplifier is gain saturated, the signal output level change is small compared with the input level change; due to this characteristic, signal variation in input signal can be reduced (also refer to the prior art cited in the conclusion, Inoue: "Suppression of Signal Fluctuation Induced by Crosstalk Light in a Gain Saturated Laser Diode Amplifier"). Refer to Figures 5 and 12 of Watanabe, which show the gain curves; as the input light intensity exceeds a predetermined value (e.g.,

P_{so} in Figure 5 or ~20 mW in Figure 12), the gain value gradually flattens. Using this property, if the average intensity (or power) of a light source having intensity noise is located in a gain saturation region, the amplitude variation of the light according to time is reduced due to the gain saturation property. As shown in Figures 5 -12 of Watanabe, reduction of the amplitude variation of the light source due to the SOA under a gain saturation driving condition means that the intensity noise of a signal channel is suppressed. That is, the gain-saturated semiconductor optical amplifier has a property that, if the gain saturation occurs, the intensity of amplified output light varies little and is constantly outputted even though the intensity of input light varies, and the reduction of the power fluctuation decreases relative intensity noise; therefore, the noise intensity is rendered substantially constant.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the gain-saturated SOA as taught by Watanabe in the system of Lee et al so that the fluctuation of the pulse intensity or the waveform can be suppressed and the intensity noise of the incoherent light source can be effectively reduced or the SOA outputs the reduced relatively constant intensity mode partition noise, and transmission distance can be increased.

6). With regard to claim 17, Lee et al and Watanabe disclose all of the subject matter as applied to claim 16 above. And Lee et al further discloses the method, further comprising the steps of:

generating light (broadband light sources 111 and 112 in Figure 1 and 611, and 612 in Figure 6) having a wide wavelength band including a plurality of incoherent lights having different wavelengths; and

outputting (4-port optical path setting 613 in Figure 6, or Figure 5) the multiplexed optical signal for said amplifying, and sending the generated light source for demultiplexing into a plurality of incoherent lights having different wavelengths so as to output the demultiplexed incoherent light among lasers ([0012]-[0014]).

7). With regard to claim 19, Lee et al and Watanabe disclose all of the subject matter as applied to claim 16 above. And Lee et al further discloses wherein the multiplexing is performed by a multiplexer/demultiplexer that includes an arrayed waveguide grating ([0061], and claim 9).

8). With regard to claim 20, Lee et al and Watanabe disclose all of the subject matter as applied to claim 16 above. And Lee et al further discloses wherein the generating is performed by lasers that include a Fabry-Perot laser for generating a respective mode-locked channel by incoherent light ([0014]).

6. Claims 6 and 10-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al (US 2003/0142978) in view of Joo et al (US 2002/0141046) and Watanabe (US 6,847,758).

1). With regard to claim 6, Lee et al disclose a bi-directional wavelength division multiplexing system comprising a central office (Central Base Station in Figure 1) for outputting a downstream optical signal comprised of downstream channels and for receiving upstream channels, a plurality of subscriber terminals (Subscriber 1 – n, in

Figure 1) for receiving said downstream channels and outputting said upstream channels, and a remote node for relaying optical communication between the central office and the subscriber terminals, wherein the central office includes:

a multiplexer/demultiplexer (110 in Figure 1) configured to demultiplex an upstream optical signal into said upstream channels so as to output the demultiplexed channels, and to multiplex a plurality of downstream channels having different wavelengths into said downstream optical signal so as to output the multiplexed optical signal ([0012]);

a plurality of photodetectors (Rx 104 – 106 in Figure 1) configured to detect each of said upstream channels demultiplexed by the multiplexer/demultiplexer;

a plurality of lasers (Tx{B} 101 – 103 in Figure 1) configured to generate mode-locked downstream channels by corresponding incoherent light received in the lasers and output the generated downstream channels to the multiplexer/demultiplexer ([0008] and [0012]-[0014]);

a plurality of wavelength selection couplers (107 – 109 in Figure 1) configured to output ones of said upstream channels, which are outputted from the multiplexer/demultiplexer, to corresponding photodetectors, outputting corresponding incoherent light to corresponding lasers, and outputting said downstream channels, which are outputted from the lasers, to the multiplexer/demultiplexer ([0011]).

Lee et al discloses two optical amplifiers (507 and 508 in Figure 5) for amplifying the downstream and upstream signals, to output the amplified upstream optical signal to the multiplexer/demultiplexer (Figure 5, the amplified signals by amplifier 507 are

outputted to Optical Multiplexer/Demultiplexer direction), and to output the amplified downstream optical signal to the remote node (the amplified signals by amplifier 508 are outputted to Remote distribution node direction).

But, Lee et al does not expressly disclose (A) one semiconductor optical amplifier amplifies both the upstream and down stream signals; and (B) the semiconductor optical amplifier configured to amplify the upstream optical signal to be demultiplexed in a gain saturation state, to amplify the downstream optical signal to be outputted by the central office in a gain saturation state, wherein a noise intensity in each of said upstream and downstream optical signals rendered substantially constant.

With regard to item (A), Joo et al discloses a system and method to amplify both the upstream and downstream optical signals in an optical communication system (Figure 3, amplifier 630). Joo et al provides an optical amplifier device that is inexpensively manufactured while having a high-integration ([0016] and [0017]).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply an bi-directional amplifier as taught by Joo et al to the system of Lee et al so that the upstream and downstream signals can be amplified by one amplifier, and then the manufacturing costs and the maintenance costs can be reduced (also refer to the prior art cited in the conclusion, US 5,608,572, which discloses a bi-directional SOA amplifier).

With regard to item (B), Watanabe, in the same field of endeavor, discloses a semiconductor optical amplifier (SOA) for amplifying an outputted optical signal in a gain saturation state (gain-saturated optical amplifier 6 in Figure 1, and Figure 6, column 9

line 23-30). By amplifying the optical signal in the gain-saturated region, the waveform distortion and the amplitude fluctuations near the peak of each pulse can be suppressed, and the transmission distance can be increased (column 8, line 23-67).

It is a well-known fact that when a amplifier is gain saturated, the signal output level change is small compared with the input level change; due to this characteristic, signal variation in input signal can be reduced (also refer to the prior art cited in the conclusion, Inoue: "Suppression of Signal Fluctuation Induced by Crosstalk Light in a Gain Saturated Laser Diode Amplifier"). Refer to Figures 5 and 12 of Watanabe, which show the gain curves; as the input light intensity exceeds a predetermined value (e.g., P_{so} in Figure 5 or ~20 mW.in Figure 12), the gain value gradually flattens. Using this property, if the average intensity (or power) of a light source having intensity noise is located in a gain saturation region, the amplitude variation of the light according to time is reduced due to the gain saturation property. As shown in Figures 5 -12 of Watanabe, reduction of the amplitude variation of the light source due to the SOA under a gain saturation driving condition means that the intensity noise of a signal channel is suppressed. That is, the gain-saturated semiconductor optical amplifier has a property that, if the gain saturation occurs, the intensity of amplified output light varies little and is constantly outputted even though the intensity of input light varies, and the reduction of the power fluctuation decreases relative intensity noise; therefore, the noise intensity is rendered substantially constant.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the gain-saturated SOA as taught by Watanabe in

the system of Lee et al and Joo et al so that the upstream and downstream signals can be amplified by one SOA and the fluctuation of the pulse intensity or the waveform can be suppressed and the intensity noise of the incoherent light source can be effectively reduced, and transmission distance can be increased.

2). With regard to claim 10, Lee et al and Joo et al and Watanabe disclose all of the subject matter as applied to claim 6 above. And Lee et al in view of Watanabe further discloses wherein the lasers include Fabry-Perot lasers ([0014]).

3). With regard to claim 11, Lee et al and Joo et al and Watanabe disclose all of the subject matter as applied to claim 6 above. And Lee et al further discloses wherein the remote node includes a multiplexer/demultiplexer (115 in Figure 1, or 618 in Figure 6) configured to multiplex said upstream channels outputted from each of the subscriber terminals into said upstream optical signal configured to output to the central office, demultiplexing upstream light outputted from the central office into a plurality of incoherent lights having different wavelengths so as to output the demultiplexed upstream light to a corresponding subscriber terminal (Subscriber 1- n in Figures 1 and 6), and demultiplexing said downstream optical signal into said plurality of downstream channels configured to output to corresponding ones of the plural subscriber terminals ([0012] and [0013]).

4). With regard to claim 12, Lee et al and Joo et al and Watanabe disclose all of the subject matter as applied to claim 6 above. And Lee et al further discloses wherein the remote node includes a multiplexer/demultiplexer (115 in Figure 1, or 618 in Figure 6) configured to demultiplex upstream light and a downstream optical signal each

configured to output to the subscriber terminals (Subscriber 1- n in Figures 1 and 6), the multiplexer/demultiplexer of the remote node multiplexing a plurality of upstream channels having different wavelengths ([0004], [0005] and [0013], specific wavelength is allocated to each subscriber), which are outputted from the subscriber terminals, into said upstream optical signal for transmission to the central office [(0013)].

5). With regard to claim 13, Lee et al and Joo et al and Watanabe disclose all of the subject matter as applied to claims 6 and 12 above. And Lee et al further discloses wherein the multiplexer/demultiplexer of the remote node uses an arrayed waveguide grating ([0061], and claim 9) demultiplexing upstream light received in the multiplexer/demultiplexer of the remote node into a plurality of incoherent lights having different wavelengths, demultiplexing said downstream optical signal into said plurality of downstream channels, and outputting the demultiplexed downstream channels and incoherent light to the subscriber terminals.

6). With regard to claim 14, Lee et al and Joo et al and Watanabe disclose all of the subject matter as applied to claim 6 above. And Lee et al further discloses wherein each of the subscriber terminals comprises:

a laser (Tx{A} in Figures 1 and 6, [0014]) configured to generate a mode-locked upstream channel by corresponding incoherent light so as to output the generated mode-locked upstream channel;

a photodetector (Rx in Figures 1 and 6) configured to detect a corresponding one of the downstream channels; and

a wavelength selection coupler (116 – 118 in Figure 1, or 619 – 621 in Figure 6) configured to output the mode-locked upstream channel to the remote node, outputting said corresponding one of the downstream channels, which is outputted from the remote node, to the photodetector, and outputting to the laser said corresponding incoherent light ([0011]).

7). With regard to claim 15, Lee et al and Joo et al and Watanabe disclose all of the subject matter as applied to claims 6 and 14 above. And Lee et al further discloses wherein the lasers include Fabry-Perot lasers ([0014]).

7. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al (US 2003/0142978) and Joo et al (US 2002/0141046) and Watanabe (US 6,847,758) as applied to claim 6 above, and in further view of Lee et al (US 2001/0004290).

Lee et al (Lee '978) and Joo et al and Watanabe discloses all of the subject matter as applied to claim 6 above. And Lee et al (Lee '978) further discloses wherein the central office further comprises:

a downstream broadband light source (Tx{B} 101 – 103 in Figure 1) configured to output downstream light having a wide wavelength band including a plurality of incoherent lights having different wavelengths ([0008] and [0012]-[0014]);

an upstream broadband light source (Tx{A} 119 – 121 in Figure 1) configured to output upstream light having a wide wavelength band including a plurality of incoherent lights having different wavelengths ([0008] and [0012]-[0014]);

wherein the multiplexer/demultiplexer (110 in Figure 1 or 610 in Figure 6) demultiplexes downstream light into a plurality of incoherent lights having different

wavelengths so as to output demultiplexed light to each of the wavelength selection couplers (107 -109 in Figure 1, or 607 – 609 in Figure 6).

But, Lee et al (US '978) does not discloses (A) a circulator located between the multiplexer/demultiplexer and the SOA, for outputting the upstream optical signal and downstream light to the multiplexer/demultiplexer, and for outputting the downstream optical signal and upstream light to the semiconductor optical amplifier; (B) a first band pass filter (BPF) located between the downstream broadband light source and the circulator, for reflecting an upstream optical signal received in the first BPF to the circulator, and for transmitting downstream light to the circulator; and (C) a second BPF located between the upstream broadband light source and the circulator, for reflecting a downstream optical signal received in the second BPF to the circulator, and for transmitting upstream light to the circulator.

With regard to item (A), Lee et al (US '978) uses two circulators and two amplifiers to form an optical path setting device (Figure 5 and 613 in Figure 6). The 4-port optical setting device 613 performs the same function as the circulator and amplifier of applicant: output the upstream optical signal and downstream light to the multiplexer/demultiplexer and amplify the signals; that is, the teaching of the reference is functionally equivalent to the claimed limitation.

With regard to items (B) and (C), Lee et al (Lee '978) discloses A-band light source and B-band light source, but not expressly disclose a band pass filter (BPF). However, Lee et al (US '290) teaches a BPF to limit the spectral width of the ASE (the BPF in Figure 5, [0084]).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use BPF as taught by Lee et al (US '290) to the system of Lee et al (US '978) in view of Watanabe so that the different band of wavelengths can be chosen and also can be used to reflect other wavelength bands, and a cost-effective WDM system can be obtained.

8. Claims 3 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al (US 2003/0142978) and Lee et al (US 2001/0004290) and Watanabe (US 6,847,758) as applied to claims 1, 2, 6 and 7 above, and in further view of Kim et al (H.D. Kim: "A Low-Cost WDM Source with and ASE Injected Fabry-Perot Semiconductor Laser", IEEE Photonics Technology Letters, Vol. 12, No. 8, August 2000, page 1067-1069).

1). With regard to claim 3, Lee et al and Watanabe discloses all of the subject matter as applied to claims 1 and 2 above. But Lee et al does not expressly state that the broadband light source is an EDFA.

However, Kim et al, teaches that the EDFA can be used as the low-cost WDM source (page 1067, left column, I. Introduction). Kim et al provides a low cost and low loss system.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the erbium-doped fiber amplifier as the broadband light source as taught by Kim et al so that a cost-effective WDM system can be obtained.

2). With regard to claim 18, Lee et al and Watanabe discloses all of the subject matter as applied to claims 16 and 17 above. But Lee et al does not expressly state wherein said generating light having a wide wavelength band is performed by a broadband light source that includes an Erbium-doped fiber amplifier (EDFA).

However, Kim et al, teaches that the EDFA can be used as the low-cost WDM source (page 1067, left column, I. Introduction). Kim et al provides a low cost and low loss system.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the erbium-doped fiber amplifier as the broadband light source as taught by Kim et al so that a cost-effective WDM system can be obtained.

9. Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al (US 2003/0142978) and Joo et al (US 2002/0141046) and Watanabe (US 6,847,758) and Lee et al (US 2001/0004290) as applied to claims 6 and 7 above, and in further view of Deng et al (US 2002/0196491).

Lee et al (US '978) and Joo et al and Watanabe and Lee et al (US '290) discloses all of the subject matter as applied to claims 6 and 7 above. But Lee et al does not expressly discloses wherein the downstream broadband light source uses an Erbium doped fiber amplifier outputting spontaneous emission light in a wavelength band of 1550 nm (claim 8); and wherein the upstream broadband light source uses an Erbium doped fiber amplifier outputting spontaneous emission light in a wavelength band of 1310 nm (claim 9).

However, Deng et al, in the same field of endeavor, teaches a downstream light having a wavelength of around 1550 nm and an upstream light having a wavelength of around 1310 nm ([0033]). Deng et al uses these two bands centered far from each other to avoid transmission penalties ([0033]).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use 1550 nm band as the B-band and 1310 nm band as the A-band as taught by Deng et al to the system of Lee et al so that the downstream and upstream bands is centered far from each other and then the transmission penalties can be avoided.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Nitta et al (US 5,608,572) discloses a bi-directional SOA amplifier.

Ohki et al (US 2004/0057485).

Delfyett et al (US 6,690,686).

Miller et al (US 4,675,873).

Inoue (Inoue: "Suppression of Signal Fluctuation Induced by Crosstalk Light in a Gain Saturated Laser Diode Amplifier", IEEE Photonics Technology Letters, Vol. 8, No. 3, March 1996, pages 458-460).

Sato et al (Sato et al: "Reduction of Mode Partition Noise by Using Semiconductor Optical Amplifiers", IEEE Journal on Selected Topic in Quantum Electronics, Vol. 7, No. 2, March/April 2001, pages 328-333).

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Li Liu whose telephone number is (571)270-1084. The examiner can normally be reached on Mon-Fri, 8:00 am - 5:30 pm, alternating Fri off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Vanderpuye can be reached on (571)272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Li Liu
October 14, 2007

KENNETH VANDERPUYE
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